

HINGE ASSEMBLY FOR ELECTRONIC DEVICES

This is a continuation of application Ser. No. 08/038,680 filed on Mar. 26, 1993 now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to hinges for electronic devices, particularly hinge assemblies for electronic devices having two or more device parts that interconnect and stably support the device parts while providing enhanced adjustability in the three-dimensional positioning of each device part relative to the other device parts, so as to enhance comfort, efficiency and effectiveness in using the electronic device.

Two-part electronic devices are common. They include personal computers of various categories such as desk-top, laptop, notebook, and palm-top computers, as well as pen-based tablet computers. Two-part electronic devices also include personal organizers and other electronic devices.

For two-part electronic devices, one device part typically is a video display. For example, portable computers typically have a flat panel display screen (the "display part"), e.g., an LCD or gas plasma display. The second device part typically is a base that holds, among other things, the bulk of the device's electronic hardware, such as disk drives (the "base part"). In portable computers, the base part also commonly holds a keyboard that may or may not be detachable from the base part. Broadly, the display and base parts can be described as typically being, in shape, rectangular prisms, having outside and inside surfaces and right, left, front and back sides.

In using two-part electronic devices, it is generally desirable to be able to adjust the relative positions of the two device parts through three dimensions substantially without restriction, while stably supporting both parts. For example, in portable computers the user may desire to adjust the vertical viewing angle of the display by rotating the display part horizontally relative to the base part. The user may desire to swivel the display part relative to the base part in order to allow a second person to view the display while not encumbering the user's access to the keyboard. The user may desire to position the display a shorter or longer distance from the user's eyes, with or without adjusting the viewing angle or the position of the keyboard. The user may desire to place the display part flat against the base part with the display exposed and the keyboard either (i) covered by the display part, for example, when input is to be pen-based, or (ii) uncovered by the display part, for example, when using the device's keyboard in conjunction with an external monitor rather than the integral display. Moreover, the user may desire to adjust the relative positions of the two device parts in these and other ways in sequence or in combination, depending on the type of electronic device and the nature of its use.

Hinge mechanisms that connect two-part electronic devices are known. They have a variety of forms, each having significant limitations, particularly by undesirably restricting the adjustability of one device part relative to the other device part. In one conventional form, the hinge mechanism is fixedly mounted to each of the device parts at or near respective sides of the parts. The hinge mechanism provides a single-axis about which both device parts rotate and does not allow translational movement of either part relative to the other. Examples of this conventional form of

hinge mechanism are shown in Matsuda et al. U.S. Pat. No. 4,852,032 and Hosoi U.S. Pat. No. 5,166,893.

A second conventional form is shown in Blonder U.S. Pat. No. 5,103,376 ("Blonder") which discloses an interconnection mechanism between a keyboard portion and a display portion of a computer wherein the position of the keyboard and display portions can be reversed. The interconnection mechanism provides rotational capability about two axes, one disposed at respective back sides of the computer portions and the second disposed at respective front sides of the computer portions. However, Blonder's positioning adjustability is undesirably limited in that it allows neither translational movement of one portion relative to the other nor independent rotation about both axes. Blonder also fails to provide positioning adjustability about an axis perpendicular to either or both of the above-identified axes.

A third conventional form is shown in Malgouires U.S. Pat. No. 5,107,402 ("Malgouires") which discloses a portable terminal having a screen part and a central unit wherein the screen part is fixed to the central unit by at least one lever, the lever having at least two articulations, one disposed at the connection between the screen part and the lever and the other disposed at the connection between the lever and the central unit. The articulations provide off-set, parallel axes about which the screen part may be positionally adjusted relative to the central unit. Malgouires is subject to significant limitations in positioning adjustability in that it provides neither translational movement of either the screen part or the central unit relative to the other nor an axis perpendicular to the above-identified axes about which the screen part and central unit may be rotated relative to each other.

A fourth conventional form is shown in Ohgami et al. U.S. Pat. No. 5,168,423 ("Ohgami") which discloses a portable computer having a base unit and a flat panel display unit wherein the base unit has a turntable rotatably connected to the base unit in a horizontal direction. A display support, at one end, is fixed to the turntable and, at the other end, is pivotally connected to the flat panel display unit. Ohgami provides positioning adjustability of the flat panel display unit relative to the base unit about the vertical axis of the turntable and about the horizontal axis of the pivotal connection, said axes being perpendicular to each other. Ohgami fails to provide, however, translational movement of either unit relative to the other and does not permit one unit to be elevated relative to the other.

Because conventional hinge mechanisms for electronic device cases, such as in laptop, notebook and palm-top computers, have inherent shortcomings, a need exists for an improved hinge mechanism.

SUMMARY OF THE INVENTION

The present invention fulfills the need for an improved hinge mechanism for electronic devices, overcomes the shortcomings of prior art hinge mechanisms and provides certain advantages not heretofore available in such mechanisms, by providing a hinge assembly that interconnects and stably supports one device part relative to another while enhancing the three-dimensional adjustability of the position of each device part relative to one or more other device parts.

In a preferred embodiment used with an electronic device having display and base parts, the hinge assembly comprises a first shaft secured at its ends to a side of the display part, with its longitudinal axis parallel to the side of the display part. A first sleeve is slidably attached to the first shaft so that